

Claims

1. An apparatus for producing simultaneously a plurality of spatially separated images comprising:
an optical system (1) arranged to produce an image associated with a first optical transfer function;
a diffraction grating (4) arranged to produce, in concert with the optical system, images associated with each diffraction order;
ancillary optical modules (5, 6, 7) operating on individual diffraction orders and means for detecting the images,
wherein the optical system (1) and diffraction grating (4) are located on an optical axis the diffraction grating (4) is located in a suitable grating plane and the ancillary optical modules (5, 6, 7) modify the optical transfer functions associated with the images
characterised in that the optical system (1) and diffraction grating (4) are arranged such that a plurality of object planes (9, 10, 11) are imaged and each image associated with a diffraction order corresponds to a different object plane.
2. The apparatus of claim 1 where the ancillary optical modules generate different amounts of defocus in the images associated with each diffraction order.
3. The apparatus of claim 1 where the ancillary optical modules generate different amounts of spherical aberration in the images associated with each diffraction order.
4. The apparatus of claim 1 where the ancillary optical modules generate different amounts of defocus and spherical aberration in the images associated with each diffraction order.
5. The apparatus of claims 3 and 4 where the spherical aberration of images associated with each diffraction order is arranged to correct for spherical aberration associated with the different thickness of substantially parallel plates in object space.
6. An apparatus according to claim 1 whereby the diffraction grating comprises a set of two or more diffraction gratings designed such that the various diffraction orders are spatially separated.

7. An apparatus according to claim 1 whereby the diffraction grating is any one of an amplitude-only diffraction grating, a phase only diffraction grating or a phase and amplitude diffraction grating and any one of a reflective or a transmissive grating and any of these in which the grating lines are not plane parallel.
8. An apparatus according to claim 1 whereby the grating is a two-level (binary), a multi-level (digitised) or a continuous-level (analogue) structure.
9. The apparatus of claim 1 where each object plane contains an array of elements, capable of existing in at least two states and in which the detector means (12, 13, 14) is capable of distinguishing between said states.
10. An apparatus for reading data from a three dimensional optical storage medium wherein object planes are located within the medium comprising an apparatus according to claim 9 wherein the detecting means (12, 13, 14) is adapted to produce a signal dependent on the state of the elements.

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